U.S. Department of Energy
Energy Efficiency and Renewable Energy

biomass program

Trace-Metal Scavenging from Biomass Syngas with Novel High-Temperature Sorbents

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Presentation Outline

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- **Project Background**
- **Pathways and Milestones**
- **Technical Feasibility and Risks**
- **Competitive Advantage**
- **Project Overview**
- **History and Accomplishments**
- **Plan/Schedule**
- **Critical Issues and Show-stoppers**
- **Plans and Resources for Next Stage**
- **Summary**

Project Background

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- Slip through PCDs can damage turbines, and heavy metals can escape to the environment, for IGCC systems and for chemicals and fuels production.
- Feedstock for chemical products are easier to process when stripped of alkaline and toxic metals, prior to processing.
- High-Temperature Sorbents have been shown to effectively react with and capture these metals in vitiated air and in flue gas.
- Eutectics form when sorbents react with metal.
- These sorbents have yet to be tested in reducing environments.
- In addition to the ability to capture metals, sorbents must be shown NOT to create a melted or sticky gue that will clog or damage the barrier filters.

Pathways and Milestones – C-level and Project Milestones

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Ag Residues **Perennial Grasses** **Woody Crops** **Pulp and Paper** **Forest Products**

Validate Cost-effective Gas Cleanup Performance

Validate integrated gasification and gas cleanup at pilot scale

Project Milestones	Type	Performance Expectations	Due Date
MDP1 Move on to next phase?	D	**Transport Gasifier** >70% Removal of Trace Metals, without damaging or plugging the barrier filter.	Jan 2006
MDP2 Move on to Demonstration?	D	**Fluidized Bed** >70% Removal of Trace Metals, without damaging or plugging the barrier filter.	Oct 2006
Project Completion	D	Successfully Demonstrate this Technology at full-scale at the Power System Development Facility (PSDF).	Dec 2007

Technical Feasibility and Risks

- Sorbents have been shown to effectively and quickly scavenge Na, Pb, Cd, and other metals from vitiated air at high temperatures.
- Sorbents have not yet been tested in reducing environments.
- Sorbents will potentially melt at high temperatures, due to eutectic formation with the captured metals.
- Project subject to test schedules in larger units that are not driven by this project (i.e., PSDF).

Competitive Advantage

- Success will eliminate corrosion issues of gas turbines and make chemical feedstocks from biomass more attractive.
- Events -- Yielding Obsolescence
  - Lack of regulation of Heavy-Metal emissions from IGCC and related systems combined with economic and durable turbine-blade coatings.
  - Indirect-fired cycles that don’t need hot-gas cleanup.
  - Effective and more economical cold-gas cleanup for chemical feedstock production.

Project Overview

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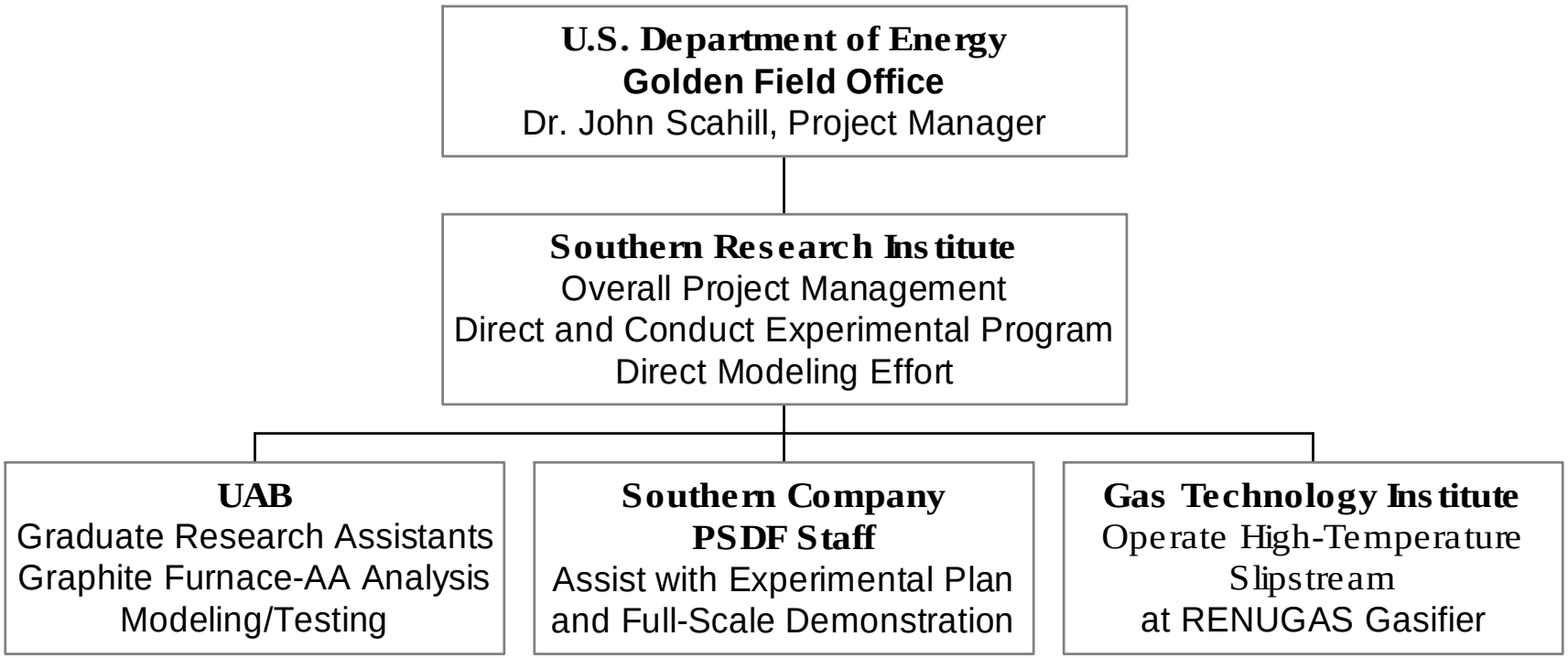
- Project Objective: Develop High-Temperature Sorbent-Injection Strategies that will effectively remove toxic and nuisance metals from syngas without damaging or plugging the barrier filter.



History and Accomplishments

- New Project
- Accomplishments
  - Obtained site-access agreement at PSDF.
  - Designed reaction chamber and sorbent and char feeders for slipstream tests at PSDF.
  - The syngas cleanup model development continues, building upon the present Na-speciation model.
    - Current Efforts include: adding K-speciation and heterogeneous mechanisms to the model.
    - Including sorbent/metal interactions.

Plan/Schedule

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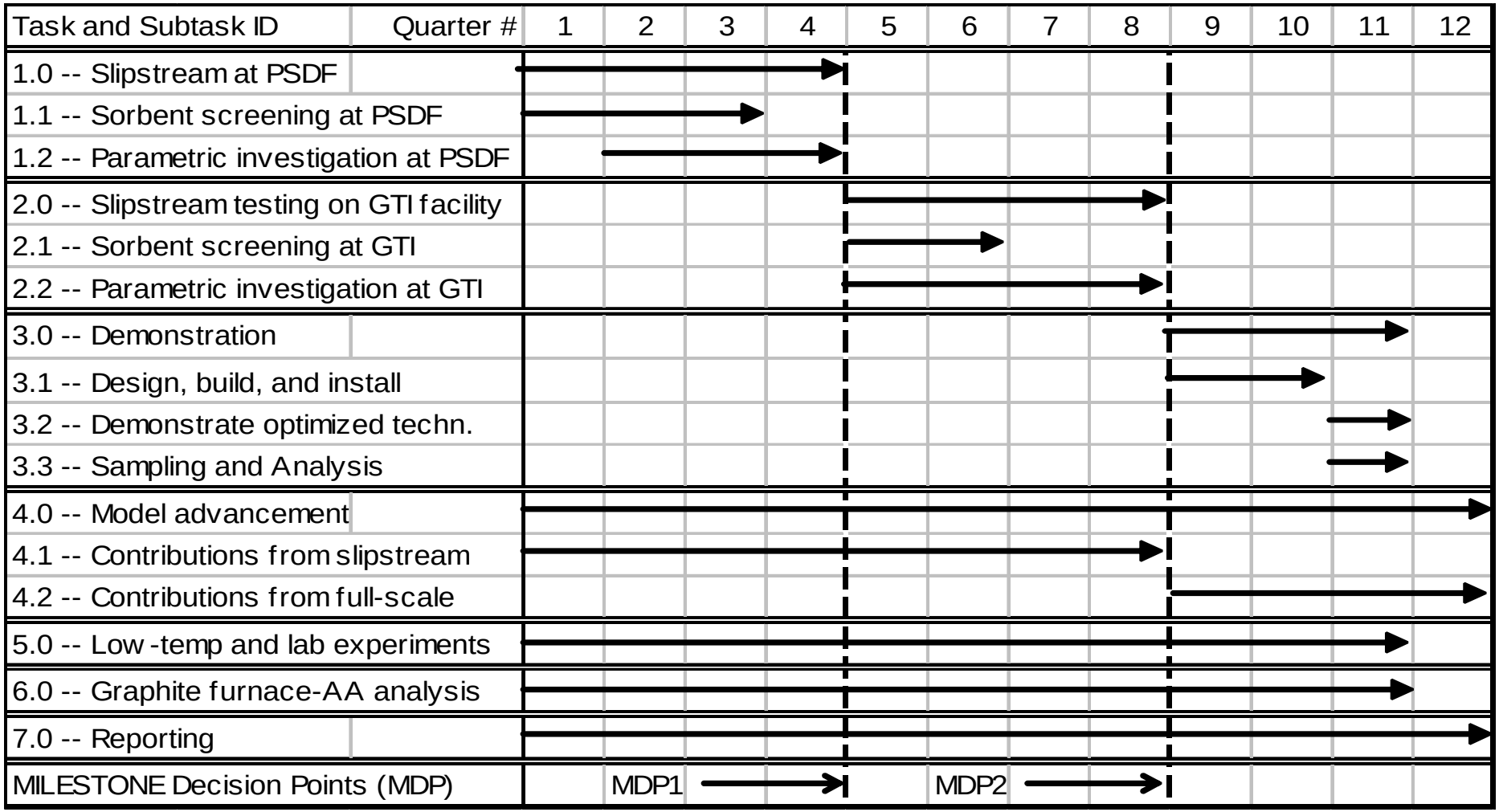

Critical Issues and Show-stoppers

- Critical Performance Parameters:
  - How does a syngas (i.e. reducing) environment affect sorbent/metal reaction mechanisms?
  - Can metal be captured without plugging or damaging the barrier filters?
  - How does temperature affect capture and melting?
- Show Stoppers:
  - No capture in reducing environment.
  - Ineffective capture without severe melting.

Plans and Resources for Next Stage

- If the early project stages are successful:
  - Full-scale PSDF demonstration in the third year.
- If the technology is shown to be effective and economic by the end of the project:
  - May become a standard technology that is used and further developed during all PSDF test runs.
  - Possible Full-Scale Demonstration in the RENUGAS gasifier.
  - Possible Demonstration at the 250 MW Gasifier to be built in Orlando Florida.
- Commercialization Partners:
  - Southern Company
  - Gas Technology Institute

Summary

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- Southern Research Institute has recently begun this project to develop high-temperature sorbents for scavenging trace metals from syngas, without damaging the barrier filter.
- We are preparing for slipstream tests at the PSDF this summer. Modeling efforts are going forward.
- We plan to complete our current efforts early next year, followed by additional slipstream testing in the RENUGAS gasifier at GTI.
- Demonstration of this technology is planed for 2007 in the full PSDF unit, if the initial stages of the project indicate a high probability of success.

Budget

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- Total Project Funding = $962,882.00
  - DOE = $769,378.00
  - Cost Share = $193,504.00
- Fiscal Year 2005 = $323,756.00
  - DOE = $259,005.00
  - Cost Share = $64,751.00